

5 **PCMCIA CARD WITH DEDICATED ON-BOARD BATTERY**

Field of the Invention

 This invention relates to integrated circuit (IC) cards compatible with Personal
Computer Memory Card International Association (PCMCIA) standards and devices that
10 include slots for receiving PCMCIA cards, and, more particularly, to a method and
apparatus for providing an "on demand" power source on the PCMCIA card that is
selectively available for use during high power operations.

Background of the Invention

15 Portable computers and other electronic devices continue to be reduced in size as
advances in technology reduce the size of components used to manufacture these devices.

 Along with this size reduction, compact slots have been provided in the devices for
receiving IC cards. In an effort to standardize IC card formats, the PCMCIA has
promulgated various standards governing the physical dimensions and interface
20 configurations of IC cards.

 In brief, the PCMCIA standards set forth, among other things, IC card physical
dimensions, electrical interface requirements between IC cards and the devices utilizing
the IC cards, and a data format for the interchange of information between IC cards and
devices utilizing IC cards. In addition to having 3 volt (130-150 mA) pins, PCMCIA slots

(both standard size and "mini-PCMCIA" slots) also have two 5-volt pins, each of which source 500 mA, thereby limiting the sourcing capability of the 5-volt pins to a total of 1A at 5 volts.

Computer manufacturers have endorsed the PCMCIA standards and have included
5 at least one slot for a PCMCIA card in virtually all laptop, sub-notebook and notebook computers. In response to the increasing popularity of the PCMCIA standards, numerous PCMCIA-compatible devices, such as hard drives, modems, local area network adaptors and wireless communication systems have been developed. For example, one wireless communication card which serves the function of a wireless modem connectable to a
10 cellular network is manufactured by Nokia under the product name D211. Sierra Wireless and others produce similar devices, referred to herein generically as "cellular IC cards".

Cellular functionality can also be integrated into combination cards that combine wireless LAN (WiFi) and cellular capability. Given these integration capabilities, the computer user can plug a card into his/her PC or laptop that provides wireless/cellular
15 capability. However, unlike many applications that use PCMCIA or similar slots, cellular hardware can have very high peak current and/or power requirements that can exceed the source capability of the PCMCIA slot for short periods of time. These peak current/power periods occur during transmit bursts, when the cellular power amplifier (PA) must transmit at power levels of over 2-3 W, worst case, and can/will draw more than the total
20 of 1 A at 5 V available from the slot. This can be particularly problematic with new high

data-rate standards, such as EDGE, which cause the PA to draw more current due to their low efficiency.

In an attempt to provide an on-demand temporary power source for use during these high-consumption periods, prior art systems have utilized a bank of large and expensive capacitors, requiring many capacitors in parallel, or one large super capacitor cell. However, the use of the capacitors is not without its drawbacks. For example, capacitors can be relatively expensive, have high leakage currents, and consume a significant amount of space on the PC board of the card, both on the board surface and in terms of height.

10

Summary of the Invention

A PCMCIA card according to the principles of the present invention comprises an on-board (integrated) storage battery and charging circuitry for same. The on-board storage battery is dedicated to operation of on-board devices that have higher current/power requirements than are available from the 3 and 5 volt pins of the PCMCIA card. For example, in a cellular device application, during high-load transmit periods, the battery is used to source the power amplifier, and during low-load periods, the battery can be charged by the on-board battery charging circuitry, preparing the battery for the next high current/power transmit burst. In a preferred embodiment, the battery comprises a very thin Li-Ion/polymer battery or equivalent.

20

Brief Description of the Drawings

Figures 1A and 1B illustrate a top and side view, respectively, of a PCMCIA card configured in accordance with the present invention; and

5 Figure 2 is a flowchart illustrating an example of steps performed in the operation of the present invention.

Detailed Description of the Preferred Embodiments

Figures 1A and 1B illustrate a top and side view, respectively, of a PCMCIA card
10 100 configured in accordance with the present invention. Figure 1A illustrates, in block diagram format, the novel elements of the present invention, i.e., the illustration of Figure 1A shows the functional elements of the present invention rather than an accurate depiction of the physical structure of PCMCIA card 100. The actual physical structure can be selected as desired within the limitations set forth in the PCMCIA standards.

15 Referring to Figure 1A, PCMCIA card 100 comprises a components section 102, the battery cell section 104, and an electrical connection section 106. Battery cell section 104 houses and one or more battery cells, for example, Lithium polymer battery cells. It is understood that the present invention is not limited to the use of Lithium polymer battery cells, and any battery cells that can be housed in a PCMCIA card and which can
20 function to operate a transmitter amplifier (or other circuitry utilizing the on-board battery)

as disclosed herein are considered to be included in the present disclosure and part of the present invention. Lithium polymer batteries are preferred in view of their ability to be constructed in a high-density and thin configuration.

The electronic components section 102 includes a PCMCIA electronics block 108,
5 which represents the standard electronics associated with a prior art PCMCIA card. In the configuration discussed herein whereby the PCMCIA card is configured to provide wireless cellular capability, PCMCIA electronics block would include a cellular transmitter/receiver and associated electronics necessary to connect to the control hardware and software of the PC. If the PCMCIA card is a multi-function card (e.g., if
10 it includes WiFi and cellular capability), then the electronics needed to perform this dual function will be included in electronic component block 108.

Transmitter amplifier 110 (in this example) is coupled to battery cell section 104 so that transmitter amplifier 110 is provided with power from battery cell section 104 during operation. Control circuitry (not shown) is coupled to transmitter amplifier 110
15 from the PCMCIA electronics block 108 to control the operation of transmitter amplifier 110 appropriately. An antenna 114 is shown coupled to transmitter amplifier 110 so that, as is well known, the power generated by transmitter amplifier 110 can be applied to a transmission antenna so that the transmitter can perform its transmission function. Although not shown, antenna 114 can be integrated as part of the PCMCIA card 100 in
20 a well-known manner.

PCMCIA card 100 is also configured to contain battery charging circuitry 112, coupled between battery cell section 104 and the PC in which the PCMCIA card is inserted.

The power required to operate the battery charging circuitry 112 is supplied by the PC in a well-known manner. If desired, the battery charging circuitry can be included in an integrated power management function for the card electronics. Many examples of products that include integrated charging functionality exist, including the Agere PCS 20XX and PSC 21XX families, and the Linear Technologies LTC 1734, LTC 1733, or LTC 4054.

Figure 2 is a flowchart illustrating an example of steps performed in the operation of the present invention in connection with a PCMCIA card that provides cellular functionality. At step 202, the PCMCIA card is inserted into the PCMCIA slot of the PC in a known manner. The PC user operates the PC for the desired functions, and at some point decides to utilize the cellular capability of the PCMCIA card. At step 204, a function call is issued indicating the need to perform a transmission function related to the cellular capability. If desired, the cellular PA or other electronic element having high peak current/power needs can be in an "always connected" configuration with respect to the battery cells so that whenever the battery power is needed, it is already available without any further action. In such a case, the process would jump directly to step 210.

For instances where it is desired to have more control over the access to the battery cells by the electronics, the battery can be switchably connectable to the electronic

elements. If this is the case, steps 206 and 208 are followed. At step 206, a determination is made as to whether or not the function requested requires the use of the alternate power source (in this example, the battery cells 104). If at step 206, it is determined that the alternate power source is required, the process proceeds to step 208, where a connection
5 is made (e.g., via any known switching devices) to the onboard battery to supply the alternate power source. In this mode, whenever the transmitter transmits, it draws the power needed for the transmission from battery cells 104. If at step 206 it is determined that the function does not require the alternate power source, the process skips step 208 and proceeds directly to step 210.

10 At step 210, the function requested is completed. At step 212, a determination is made as to whether or not the onboard battery needs charging. If during the completion of the function, there was no need to connect to the onboard battery source, the system can be configured to automatically skip step 212 and move directly to step 214. If at step 212 it is determined that the onboard battery needs charging, at step 216 the charging
15 process is commenced to charge the battery. Alternatively, the charging process can be continuous, with charging terminated only when battery top-off has been completed. The process then proceeds to step 214 to wait for the next function call. The entire process (all steps) is repeated until the PCMCIA card is removed or is no longer being used by the PC.

The need for charging of the battery is typically determined by monitoring the battery voltage or by "fuel gauging" the battery to determine how much charge the battery contains. In some situations, self-leakage may occur even though the battery has not been used at all. Thus, it is understood that the monitoring of the battery for its level of charge
5 may occur independently of whether or not the battery has been in use.

In the above example, the system is described in which the PCMCIA card is used to access cellular service. It is understood, however, that the present invention is not so limited, and that the present invention applies to any system in which there is a need for a short-term current/power source to be supplied to components residing on the PCMCIA
10 card. It is understood that while the above example illustrates a situation where the present invention is used to provide current/power that exceeds the current/power available from the primary device, the present invention can also be applied to provide current/power to components in the PCMCIA card when the primary device is operating off of its own battery power, so that the drain on the battery of the primary device is reduced.

15 Although the present invention has been described with respect to a specific preferred embodiment thereof, various changes and modifications may be suggested to one skilled in the art and it is intended that the present invention encompass such changes and modifications as fall within the scope of the appended claims.